

REMARKS

Claims 6, 8-13, and 16-25 are pending. Claims 6 and 8-13 have been amended. Claims 18-25 have been added. Claims 1, 3-5, 7, 14, and 15 have been cancelled.

Applicants thank Examiner Patel for speaking by telephone with Applicants' representatives on March 12, 2008. Applicants' representatives began by describing an embodiment of the claimed invention. The discussion then turned to claim 6 and distinctions between the claimed invention and Hsu et al. (U.S. Patent No. 6,587,601) ("Hsu"), which forms a basis for all rejections in the outstanding Office Action. The Examiner maintained that Hsu discloses detecting objects based at least in part on a background correspondence field, as recited in claim 6 prior to the present amendment. The Examiner suggested that Applicants amend the independent claims to recite a "dense background correspondence field" and the limitations of dependent claims 7 and 8. Applicants have amended the claims accordingly in order to advance prosecution of this application.

Because some claims have been cancelled and others amended, most of the pending rejections are now moot. The limitations of dependent claim 7 have been incorporated into base claim 6. Therefore, for purposes of traversing the rejection, claim 6 will be treated as if rejected for the reason stated with respect to former claim 7. Similarly, the limitations of dependent claim 14 have been incorporated into base claim 13. Therefore, for purpose of traversing the rejection, claim 13 will be treated as if rejected for the reason stated with respect to former claim 14. Applicants' decision to "bring up" dependent claims is not an admission that the base claims were unpatentable over the cited art. To the contrary, Applicants' amended the base claims to advance prosecution of this application. Applicants expressly reserve the right to pursue the broader claims in a continuation application.

The limitations recited in amended claim 6, which incorporates the limitations of former dependent claim 7, stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Guo et al. (U.S. Patent No. 6,353,678) (“Guo”) in view of Hsu et al. (U.S. Patent No. 6,587,601) (“Hsu”) in further view of Brandt et al. (U.S. Patent No. 6,646,655) (“Brandt”). The rejection is respectfully traversed.

Claim 6 recites a “method for efficiently generating a novel viewpoint image of a scene.” The method comprises, “acquiring a pair of background images of the scene; generating a dense background correspondence field based on the background images; acquiring a pair of real-time images of the scene; warping a first image of the real-time image pair into correspondence with a second image of the real-time image pair based on the dense background correspondence field; differencing the second real-time image and the warped first real-time image; determining that difference values above a threshold correspond to pixels associated with novel objects; generating new correspondence data based on a correspondence search between the first and second real-time images, wherein the correspondence search is confined to the pixels associated with the novel objects; and warping a real-time image based on the new correspondence data to create the novel viewpoint image.”

Guo discloses a system and method for detecting moving objects in a three-dimensional scene. Guo fails to teach or suggest, however, the particular method for detecting novel objects and generating a novel viewpoint image claimed by Applicants. More specifically, Guo is entirely silent with respect to generating a dense background correspondence field and using it to efficiently detect novel objects in subsequent images. Indeed, the Office Action correctly concludes that Guo does not teach or suggest many aspects of the claimed invention, including “generating a background correspondence field based on the background images; detecting movable objects in the real-time images based at least in part on the background correspondence field; generating new correspondence data based at least in part on the movable objects.” (Page 5, Paragraph 6) Therefore, the Office Action relies on Guo in combination with Hsu.

Hsu discloses a system and method for aligning an input image (e.g., an image captured by a reconnaissance aircraft) with geographically-calibrated reference imagery (e.g., a map). Once the images are aligned, information associated with the reference image (e.g., the location of man-made features like buildings and roads) can be overlaid upon or otherwise used in conjunction with the input imagery. (Abstract) According to Hsu, the reference image is warped and the degree to which the reference image and the input image correspond is quantified by comparing the relative intensities of corresponding points in the images. (Col. 4, Lines 18-23 and Col. 5, Lines 20-27)

The Office Action asserts that Hsu discloses “generating a background correspondence field based on the background images” and directs Applicants to four portions of the Hsu specification. (Page 5, Paragraph 6) Applicants agree Hsu discloses identifying a correspondence between a reference image and an input image, as describe above, but this is very different than “generating a dense background correspondence field based on the background images,” as claimed by Applicants. As used in the art, “correspondence field” refers to an array of vectors quantifying a translation (i.e., an offset) between a pixel in one image and a corresponding pixel in another image. A “dense correspondence field” is a correspondence field having one such vector for all or almost all pixels (except occluded pixels, for example). (Specification, Page 7, Lines 10-12) Hsu discloses identifying a correspondence between images generally but is silent with regard to generating a “dense correspondence field,” as claimed by Applicants. This distinction is significant because Applicants’ dense correspondence field is used to improve the efficiency of novel object detection in subsequent images, as discussed further below. Hsu does not recognize this efficiency. Moreover, Applicants claim “generating a dense background correspondence field based on the background images” whereas Hsu teaches identifying correspondences between a reference image and an input image. As just noted, a purpose of Applicants’ generating the claimed dense background correspondence field is to improve the efficiency of subsequent operations to identify novel objects in input (i.e., “real-time”) images. By failing to determine a dense background correspondence field and skipping directly to reference/input image comparison, Hsu fails to achieve this efficiency.

The Office Action also asserts that Hsu discloses “detecting movable objects in the real-time images based at least in part on the background correspondence field” but provides no citation to any portion of the Hsu specification. Applicants disagree with the Office Action’s assertion but have replaced this limitation with the limitations of claim 7 in order to advance prosecution of this application. The Office Action correctly concludes that the Guo and Hsu combination does not teach or suggest these limitations. (Page 7, Paragraph 11) Therefore, the Office Action relies on Guo and Hsu in further combination with Brandt.

Brandt discloses a system and method for automatically identifying and extracting slides (i.e., graphics used during an oral presentation) from a video of the presentation. (Abstract) Brandt’s purpose is to provide a higher-quality view of the slides that would be provided by video as viewed by a user due to, for example, compression artifacts in streaming digital videos. (Col. 1, Lines 10-48)

The Office Action asserts that Brandt discloses “warping a first image of the real-time image pair into correspondence with a second image of the real-time image pair.” (Page 7, Paragraph 11) While Applicants disagree that Brandt anticipates this or other limitations for which it is cited, Applicants have amended the limitation to more clearly recite its relationship to other claim elements and thereby more clearly distinguish over Brandt. Amended claims 6 reads, “warping a first image of the real-time image pair into correspondence with a second image of the real-time image pair based on the dense background correspondence field.” Brandt warps a successive pair of video frames into correspondence by directly comparing the frames to each other. (Col. 6, Lines 34-38) This is very different than warping two images into correspondence based on a dense background correspondence field, as claimed by Applicants. As noted above and taught by Applicants’ specification, using a dense background correspondence field to identify correspondences between subsequent images is more efficient than a brute force comparison of the subsequent images to each other. Brandt fails to teach or suggest at least this limitation of Applicants’ claimed invention or the efficiency gains derived therefrom.

For at least all of these reasons, Applicants respectfully submit that claim 6 is allowable over the cited references. Therefore, the rejection of claim 6 should be withdrawn and the claim allowed.

Claim 8 depends from claim 6 and adds several additional limitations, including “determining a distance between each spatial group and the background.” The Office Action contends that Brandt discloses this and the other limitations of claim 8. Applicants respectfully disagree.

Brandt detects the translation of elements in a two-dimensional scene (i.e., a slide) to compensate for camera motion. See, for example, Col. 6 at Line 20, which refers only to “x-axis and y-axis translation.” Brandt thus fails to disclose “determining a distance between each spatial group and the background,” as claimed by Applicants, since “background” implies a three-dimensional environment. Indeed, Brandt refers specifically to a “foreground change detector that specifies a bounding box around an area of change between successive frames.” (Col. 6, Lines 21-24) Detecting two-dimensional foreground motion is very different than detecting motion in three-dimensions, such as between a spatial group and the background. For at least this reason and the reasons stated above with respect to base claim 6, Applicant respectfully submits that claim 8 is allowable over the cited references. Therefore, the rejection of claim 8 should be withdrawn and the claim allowed.

Claims 9-12 and 18-22 depend from claim 6 and are allowable over the cited references for at least the reasons stated above with respect to claim 6 and on their own merits. Therefore, claims 9-12 and 18-22 should be allowed.

The limitations recited in amended claim 13, which incorporates the limitations of former dependent claim 14, stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Merchant (U.S. Patent No. 4,635,203) (“Merchant”) in view of Hsu in further view of Brandt. The rejection is respectfully traversed.

Claims 13 recites a “system for efficiently generating a novel viewpoint image of a scene.” The system comprises “a plurality of cameras” and a processor configured to “generate a dense background correspondence field based on background images captured by the cameras; warp a first subsequent image from a first camera of the plurality of cameras into correspondence with a second subsequent image from a second camera of the plurality of cameras based on the dense background correspondence field, wherein the first and second subsequent images are captured simultaneously; detect a new object in the first subsequent image based on differences in corresponding pixel values of the first and second subsequent images; generate new correspondence data based on a correspondence search between the first and second subsequent images, wherein the correspondence search is confined to the pixels associated with the novel objects; and warp at least one of the subsequent images based at least in part on the new correspondence data to create the novel viewpoint image.”

Merchant discloses a system and method for computing distances based on stereo image pairs. (Abstract) While Merchant does disclose “a plurality of cameras configured to capture at least partially overlapping images of the scene,” Merchant is silent with respect to many other limitations of claim 13. The Office Action does not directly explain how Merchant is applied to claim 13, but instead refers to the rejection of claim 1. In that regard, the Office Action correctly concludes that Merchant does not teach or suggest many limitations, including “using predetermined background based correspondence fields to detect novel objects; and assigning the image representations for these objects likely new correspondences; and using the resulting correspondences to, constructs [sic] a novel viewpoint image by warping at least one of the images. Wherein [sic] the novel viewpoint image corresponds to a view from a location different than a camera location.” (Page 3, Paragraph 1)

Contrary to the Office Action's assertion that "claim 13 is a corresponding system claim of the claim 1" and instruction to "see the explanation of Claim 1," Applicants respectfully submit that the limitations of claim 13, both as previously presented and as currently amended, are substantially different from the limitations of claim 1. Applicants respectfully request that references be applied to the limitations of all claims against which they are cited with specificity, so Applicants are able to respond fully to the Office Action's position.

In any event, the Office Action correctly concludes that Merchant fails to teach many other limitations of claim 13. Thus, the Office Action relies on Merchant in combination with Hsu and Brandt. However, Hsu and Brandt fail to teach or suggest these additional limitations for at least the reasons stated above with respect to claim 6. For at least all of these reasons, the rejection of claim 13 should be withdrawn and the claim allowed.

Claims 16, 17, and 23-25 depend from claim 13 and are allowable over the Merchant, Hsu, and Brandt combination for at least the reasons stated above with respect to claim 13 and on their own merits. Therefore, the rejection of claim 16, 17, and 23-25 should be withdrawn and the claims allowed.

In view of the above, Applicants believe the pending application is in condition for allowance and respectfully request that it be passed to issue.

Dated: April 21, 2008

Respectfully submitted,

By 

Mark J. Thronson

Registration No.: 33,082
DICKSTEIN SHAPIRO LLP
1825 Eye Street, NW
Washington, DC 20006-5403
(202) 420-2200
Attorney for Applicant